FEP OUTPUT FORMAT
TELEMETRY PACKET DEFINITION

OVERVIEW

Telemetry data processed by the CCS Front-End Processor (FEP) will be delivered to direct recipients in telemetry packets. The format for these packets and the data they contain is referred to as the FEP Output Format (FOF). The Telemetry Distribution Format (TDF) used to provide requested data to users and applications is similar to the FOF with the following differences: (1) the TDF Header Record contains only one time field, the Spacecraft Time; (2) the TDF Element Record contains an 8-character Mnemonic ID and the FOF does not; and (3) the FOF Element Record contains both the raw and EU-converted values in separate fields while the TDF contains only one field that can hold either one (if both are desired, two TDF element records would be required). The two additional time fields in the FOF Header Record are used for the merge process, but are not archived with the telemetry.

An Application Program Interface (API) will be provided to isolate users of the data from format concerns. The API will contain all the necessary methods for extracting data and presenting it to the user.

DETAILS

Each telemetry packet is a structure consisting of a header segment containing information about the packet followed by telemetry element segments. Each telemetry element segment contains one spacecraft telemetry or derived parameter in both raw and Engineering Unit formats, along with its numeric identifier and associated flags.

There is a packet for each unique spacecraft time for which telemetry data is received. For 4 Kbps telemetry, this is one packet per minor frame; for 32 Kbps data, it's two packets per minor frame. This is because 32-Kbps minor frames contain super-commutated parameters that occur twice in the minor frame resulting in an effective sampling rate of 40 Hz. The second occurrence of each of these super-commutated parameters is stored in a separate packet with a time that is 25 ms later than the first packet. Thus while minor frames are generated at 20 Hz, the resulting FOF packets are generated at 40 Hz.

The data stream consists of a sequence of packets each consisting of a header segment corresponding to a specific spacecraft time followed by a telemetry element segment for each decommutated parameter sampled at that time.

Descriptions of the Telemetry Data Packets are provided in the Table 1 below.

Table 1. Definitions of Fields in the FOF

Item Name	Bit Size	Type	Item Description
FOF Packet Header Segment			

CCS Data Format Specification

Item Name	Bit Size	Type	Item Description
Spacecraft Time	64	IEEE Flt. Pnt.	Time defined by the vehicle clock count converted to UTC and expressed as modified Astronomical Julian Day.
NGT Receipt Time	64	IEEE Flt. Pnt.	UTC of time NGT transmitted the data to CCS expressed as modified Astronomical Julian Day
CCS Receipt Time	64	IEEE Flt. Pnt.	UTC of time data was received by CCS expressed as modified Astronomical Julian Day
Number of Elements	16	positive integer	Number of Telemetry Element Segments in the packet
Data Source	8	bits	Identifies various characteristics of the data source as shown in Table 2.
Telemetry Format	8	positive integer	Identifies telemetry format. Integer codes between 0 and 255 will be assigned to all existing formats as shown in Table 3. Additional codes will be assigned for new formats as necessary.
FOF Element Segment			
EU Value	64	IEEE Flt. Pnt. or ASCII	Parameter value converted to engineering units. Value may be 8-byte character, 4-byte floating point, or 8-byte double precision floating point (see EU Type).
Raw Value	32	raw Tlm. bits	Parameter raw value as stored by the spacecraft
Numeric ID	16	positive integer	Unique identifier for the parameter
Flags	16	bits	Associated flags (see Table 4)
EU Type	8	ASCII	Indicates the format of the EU Value field; C = 8-byte character; D = 8-byte double precision floating point; F = 4-byte floating point; N = no converted value. **NOTE: the requirement for double precision has not been established and is being included for possible future expansion.**

Notes

1. Numeric ID: This is a unique integer assigned to each telemetry point for the life of the mission even if the point is eliminated.

2. Data gaps are identified in two ways: a Boolean gap pseudo-parameter, packaged as an element segment, indicates gaps at the data stream level (missing minor frames), whereas initial and final point flags indicate missing values for an individual element.

   It is possible for either mechanism to indicate a gap but not the other. For example, several minor frames may be lost without losing values for a parameter that is sampled so infrequently that the gap fits between adjacent measurements of that parameter. In this case, the gap pseudo-parameter will indicate the missing minor frames, however, only those parameters for which values were actually lost will show a gap indicated by the initial and final point flags.

   Likewise, if only a portion of a minor frame is corrupted, there will be gaps in the affected elements indicated by initial and final point flags even though the gap pseudo-parameter won't indicate missing minor frames.

   For packets containing valid engineering telemetry data, the gap pseudo-parameter will have the value zero. When a gap occurs, a "gap packet" will be issued immediately following the last packet containing valid telemetry, which contains only one element, the gap pseudo-parameter set to the value one. The FEP will continue to send "gap packets" at a 40 Hz rate until data resumes.

3. The data source flags are all set in the FEP and are transferred from the FOF to the TDF unchanged.

Table 2. Definitions of Flags in the FOF/TDF Header Data Source Field

BIT	FLAG NAME	DESCRIPTION
0 (lsb)	Spacecraft Data Mode	0 indicates recorded data (ETR/SSR) 1 indicates Real-Time data
1	Ground Station Mode	0 indicates direct feed through ground station 1 indicates replay of ground station recorded data
2	CCS Mode	0 indicates operational data 1 indicates test data
3	FEP Mode	0 indicates external data source 1 indicates FEP is replaying pre-recorded data for testing
4	FEP Replay	Set to 1 if data is being supplied in response to an FEP replay request
5	Era	0 if data was captured by CCS 1 if data was converted AEDP/ESS data
6-7	Spare	

Table 3. Telemetry Format Identifier Code Definitions for the FOF/TDF Header

Code	Format		Code	Format		Code	Format		Code	Format
0	off		37	HF		80	PN		163	U
5	XN		40	FN		81	PF		186	ZN
6	XF		41	FF		82	NSSC-1 Dump		187	ZF
24	TN		48	C		138	M		192	AN
25	TF		64	YN		145	S		193	AF
36	HN		65	YF		146	D/E		others	spare

Table 4. Definitions of Flag Bits in the FOF/TDF Element Flags Field

BIT	FLAG NAME	SET BY	DESCRIPTION
0 (lsb)	Corrected Spacecraft Time	FEP and Merge	Set to 1 if VCC was bad and S/C Time has been corrected; also used for D/E format data
1	Quality	FEP	Set to 1 if data quality is questionable
2	Limit Low	FEP	Set to 1 if out of limits low
3	Limit High	FEP	Set to 1 if out of limits high
4	Limit Level	FEP	Set to 1 if beyond severe limit (red)
5	Delta Error	FEP	Set to 1 if delta limit exceeded
6	Alternate limits	FEP	Set to 1 if alternate limits should be used
7	EU Conversion Error	FEP	Set to 1 for conversion error
8	No EU Conversion	FEP	Set to 1 if no EU conversion is defined in the PRD for this element
9	Initial Point	FEP	Set to 1 if first point after gap, start of contiguous span
10	Final point	Merge	Set to 1 if last point before gap, end of contiguous span
11	Reconstructed Point	Data Mgt	Set to 1 if this point was added to "changes only" data to construct "all points" data.
12-15	Spare		